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THE DEW POINT HYGROMETER
MODEL 880
INSTRUCTION MANUAL
TM71-174

REVISED SEPTEMBER 1977

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EG&G Report No.
B-4468A

THE DEW POINT HYGROMETER
MODEL 880
INSTRUCTION MANUAL
TM71-174

SEPTEMBER 1977

Prepared by

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TELEX 92-3429

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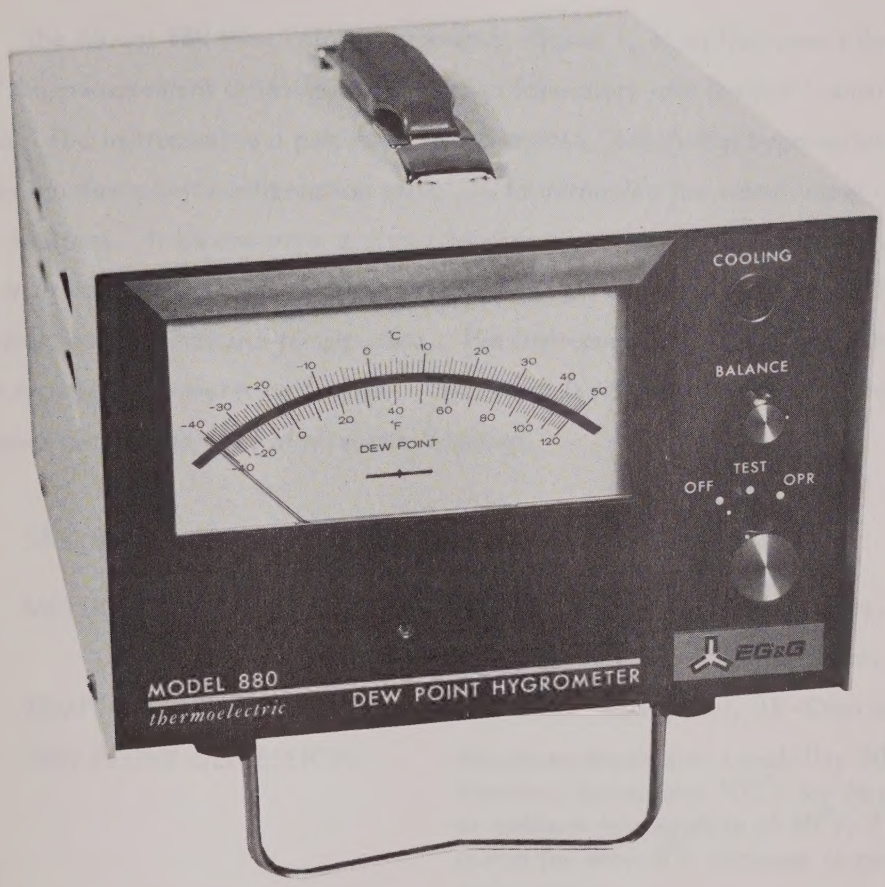


Figure 1. Model 880 Dew Point Hygrometer.

SECTION 1
INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model 880 Dew Point Hygrometer, Figure 1, is an instrument designed for use in the measurement of moisture in gases in laboratory and limited industrial applications. The instrument is a portable, line operated, bench-top hygrometer which utilizes the dew point condensation principle to determine the water vapor concentration in gas mixtures. It incorporates a direct reading, front panel dew point temperature meter with both Fahrenheit and Centigrade scales which can also be used with a remote thermistor probe to measure temperature. The instrument provides a 0 to 50-millivolt output to record the meter deflection. The sensor is normally mounted at the rear of the instrument but can be used at a remote location.

1.2 SPECIFICATIONS

METER SCALE:	$-40^{\circ}F$ to $+120^{\circ}F$, $2^{\circ}F$ increments. $-40^{\circ}C$ to $+50^{\circ}C$, $1^{\circ}C$ increments.
TEMPERATURE READOUT:	Thermistor (nonlinear), 1K-Ohm at $25^{\circ}C$.
DEW POINT DEPRESSION:	Maximum depression capability $80^{\circ}F$ for Standard Sensor and $100^{\circ}F$ for Accessory Sensor, at ambient temperature of $80^{\circ}F$; $1^{\circ}F$ depression is lost for each $3^{\circ}F$ decrease in ambient temperature.
OUTPUT:	0 to 50 mV proportional to $-40^{\circ}C$ to $+50^{\circ}C$ scale.
SAMPLE PRESSURE:	2 psia to 60 psia - Standard Sensor. 2 psia to 200 psia - Accessory Sensor.
SAMPLE FLOW RATE:	0.5 SCFH to 5 SCFH.
INSTRUMENT AMBIENT TEMPERATURE:	$+40^{\circ}F$ to $+120^{\circ}F$.
COOLING RATE:	$4^{\circ}F$/sec, maximum.
RESOLUTION:	$0.5^{\circ}F$, nominal.
ACCURACY:	$\pm 1^{\circ}F$, maximum.
POWER:	50W, 115V, ac, ±10%, 50-70 Hz. Can convert to 230V, ac.
WEIGHT:	12 lb.

1.3 ACCESSORIES

1.3.1 880-S2, Accessory Sensor

This sensor extends the depression capability to 100°F below an ambient of 80°F and increases the allowable sample pressure to 200 psia.

1.3.2 880-RK, Remote Mounting Kit

The kit is designed to provide a remote sensor mount up to 25 feet from the instrument. It consists of a 25-foot sensor extension cable for the sensor heat sink/mounting bracket.

1.3.3 880-XC, Extension Cable

Cables are available in 25-foot lengths to extend the remote mount up to a maximum of 100 feet.

1.3.4 880-SS, Sampling System

The sampling system consists of a diaphragm pump, a purge meter and 8 feet of flexible polypropylene tube with the necessary fittings to draw a gas sample through the sensor.

1.3.5 Model 880 DC/AC Inverter

The inverter converts a 12V, dc, storage battery power to 115V, 60 Hz power for portable field applications.

1.3.6 880-AT, Temperature Sensor

A 1000-Ohm (at 25°C) thermistor in a 4-1/2 in. stainless steel probe with 1/8-NPT compression fitting and 10 feet of electrical cable. Calibrated to read out directly on the Model 880 panel meter when connected to the rear terminals.

1.3.7 880-SK, Spare Parts Kit

This kit consists of the sensor cleaning materials, spare O-ring, panel lamp and spare fuses and is designed for field service. One kit is shipped with each instrument.

1.3.8 880-WJ, Water Jacket

The water jacket consists of an aluminum water-cooled heat sink. Inlet and outlet connections are 1/8" Female NPT and approximately 1/4 gal/minute of water at 150 psig maximum is required.

1.3.9 880-SU, Sensor Selector Unit

Allows four (4) Dew Point and Ambient Temperature Sensors to be used with a single control unit. Each Dew Point Sensor has its own balance feature permiting switching without rebalancing.

SECTION 2
INSTALLATION PROCEDURES

2.1 MECHANICAL INSTALLATION

The mechanical dimensions and weight for the thermoelectric dew point hygrometer are shown in Figure 2, the control drawing, Dew Point Hygrometer, Model 880. The instrument is designed for bench-top mounting. Plastic feet support the instrument or, if desired, a wire bail is mounted between the front feet to elevate the front of the instrument. The instrument should be used in an area where the ambient temperature is between +40°F and +120°F and where free air circulation is provided for convection cooling. The area should be free of vibration as excessive vibration will adversely affect the meter readability.

The 880-S Sensors shown in Figures 3 and 4 are restricted to the +40°F to +120°F ambient temperature range when installed on the instrument. On remote installation the sensor ambient temperature range is -40°F to +160°F.

2.2 ELECTRICAL INSTALLATION

The Model 880 hygrometer is provided with a standard 3-wire line cord for use with a grounded 115V, 60 Hz power outlet. The instrument draws up to 50W and is fused by means of a 3/4 - ampere slo-blo fuse located on the chassis. The instrument can be converted to the 230V operation mode by removing the power lead from the transformer (T1) Terminal 2 and soldering to Terminal 3.

The rear terminal strip provides an electrical output for recorder applications. The output is 0 to 50-mV, dc, from a source impedance of 1000 Ohms. Recording equipment used with the Model 880 should have an input resistance of 100K-Ohms or greater. Two terminals are also provided for a remote thermistor connection and are used in conjunction with the rear panel switch. These terminals have low voltages and are not dangerous to touch.

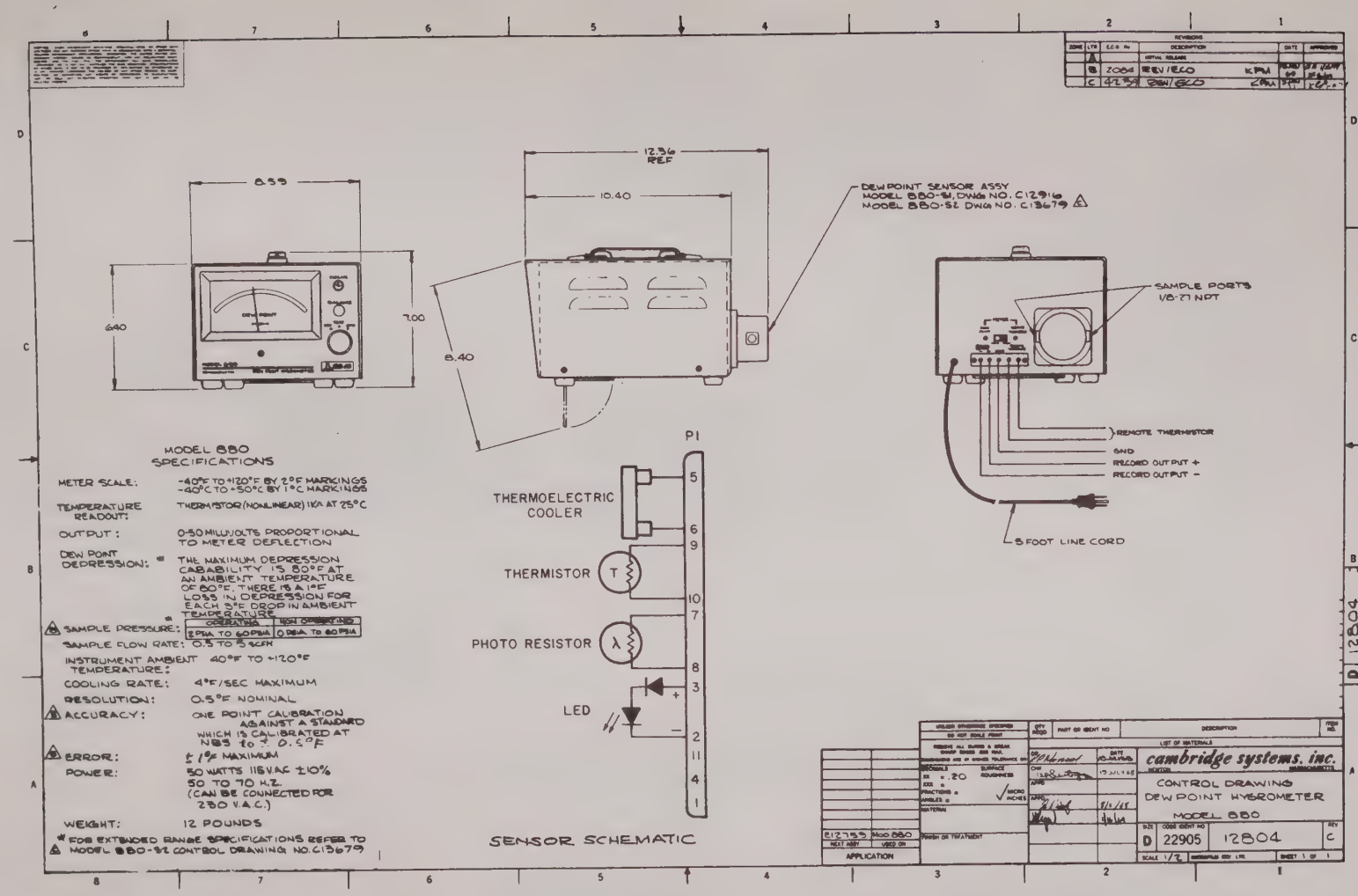


Figure 2. Control Drawing, Dew Point Hygrometer, Model 880.

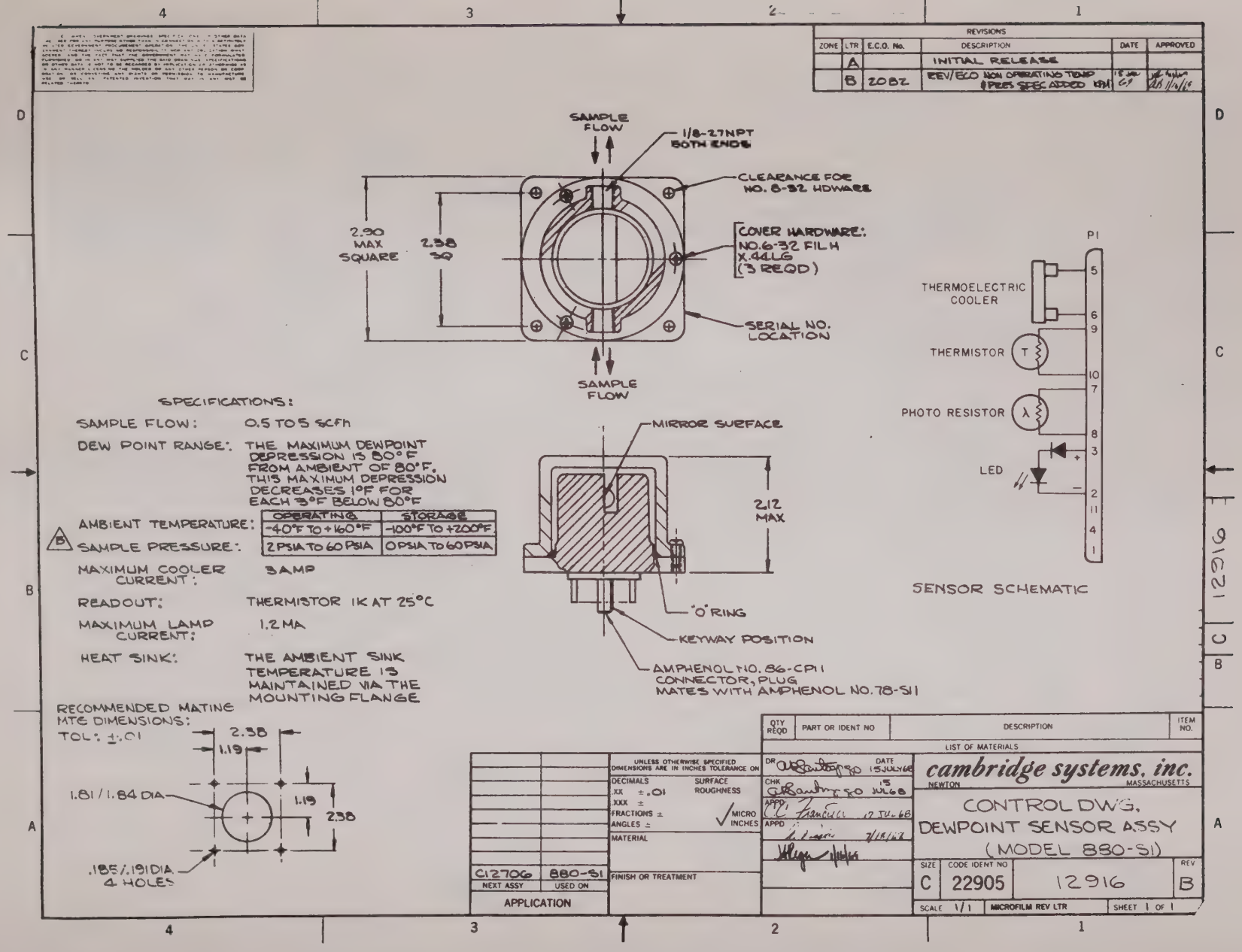

REVISIONS
ZONE | LTR | E.C.O. No. | DESCRIPTION | DATE | APPROVED
A | INITIAL RELEASE
B | 20BZ | REV/ECO NON OPERATING TEMP & PREV SPEC ADDED KM
SAMPLE FLOW
1/8-27NPT BOTH ENDS
CLEARANCE FOR NO. 8-32 HDWARE
COVER HARDWARE: NO.6-32 FIL H X.44LG (3 REQD)
SERIAL NO. LOCATION
2.90 MAX SQUARE
2.38 SQ
SAMPLE FLOW
SPECIFICATIONS:
SAMPLE FLOW: 0.5 TO 5 SCFH
DEW POINT RANGE: THE MAXIMUM DEWPOINT DEPRESSION IS 80°F FROM AMBIENT OF 80°F. THIS MAXIMUM DEPRESSION DECREASES 1°F FOR EACH 3°F BELOW 80°F
AMBIENT TEMPERATURE: OPERATING -40°F TO +160°F; STORAGE -100°F TO +200°F
B SAMPLE PRESSURE: 2 PSIA TO 60 PSIA; 0 PSIA TO 60 PSIA
MAXIMUM COOLER CURRENT: 3 AMP
READOUT: THERMISTOR 1K AT 25°C
MAXIMUM LAMP CURRENT: 1.2 MA
HEAT SINK: THE AMBIENT SINK TEMPERATURE IS MAINTAINED VIA THE MOUNTING FLANGE
MIRROR SURFACE
2.12 MAX
"O" RING
KEYWAY POSITION
AMPHENOL NO. 86-CP11 CONNECTOR, PLUG MATES WITH AMPHENOL NO. 78-S11
P1
THERMOELECTRIC COOLER
THERMISTOR
PHOTO RESISTOR
LED
SENSOR SCHEMATIC
RECOMMENDED MATING MTG DIMENSIONS:
TOL: ±.01
2.38
1.19
1.81 / 1.84 DIA
1.19
2.38
.185/.191 DIA 4 HOLES
QTY REQD | PART OR IDENT NO | DESCRIPTION | ITEM NO.
LIST OF MATERIALS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON
DECIMALS .XX ±.01 .XXX ± FRACTIONS ± ANGLES ±
SURFACE ROUGHNESS MICRO INCHES
MATERIAL
FINISH OR TREATMENT
C12706 NEXT ASSY | 880-S1 USED ON
APPLICATION
DR DATE 15JULY68
CHK 15 JUL68
APPD 17 JUL 68
APPD 7/19/68
cambridge systems, inc.
NEWTON MASSACHUSETTS
CONTROL DWG. DEWPOINT SENSOR ASSY (MODEL 880-S1)
SIZE C | CODE IDENT NO 22905 | 12916 | REV B
SCALE 1/1 | MICROFILM REV LTR | SHEET 1 OF 1

Figure 3. The Dew Point Sensor Assembly, 880-S1 Control Drawing.

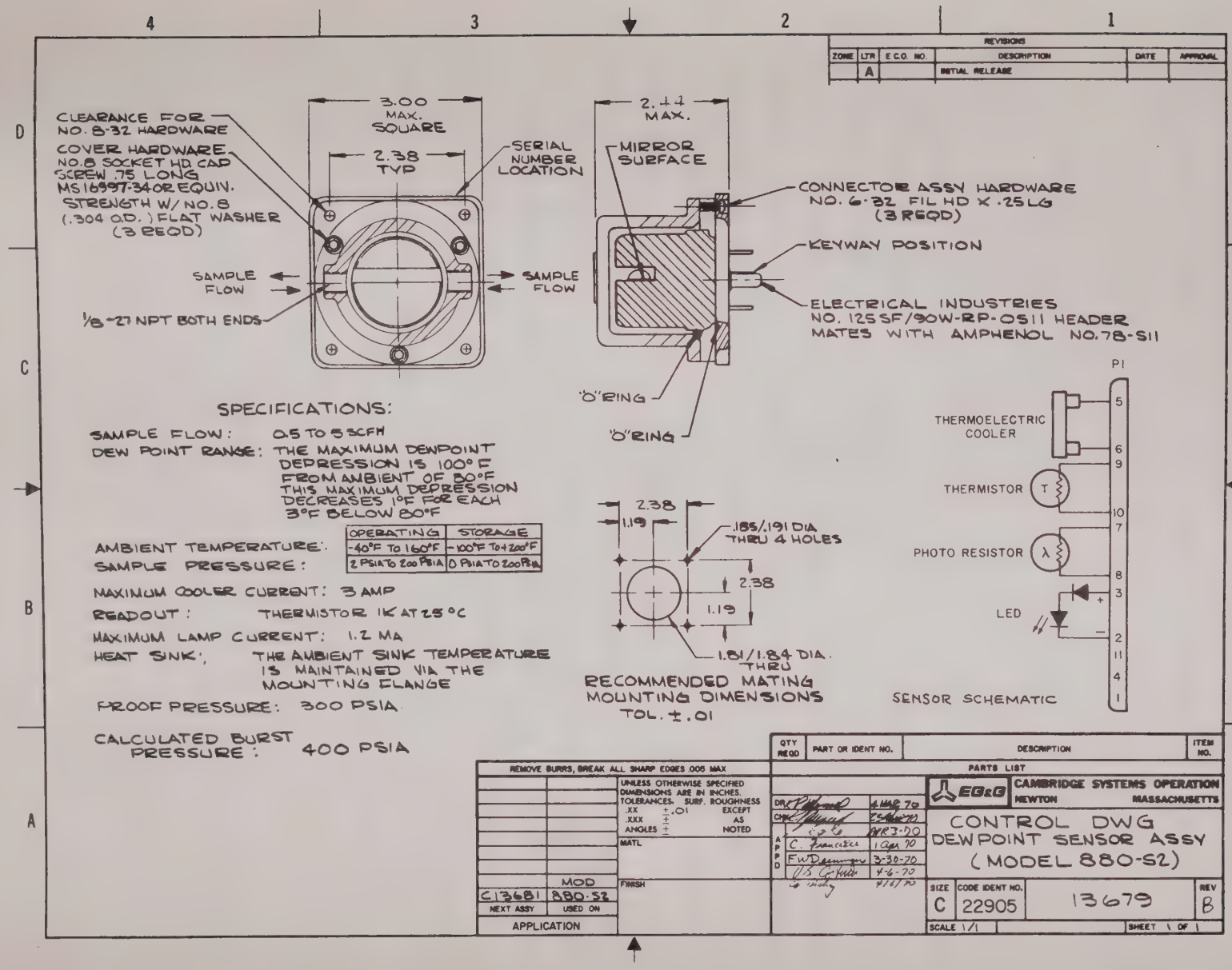

REVISIONS
ZONE | LTR | E.C.O. NO. | DESCRIPTION | DATE | APPROVAL
A | INITIAL RELEASE
3.00 MAX. SQUARE
2.38 TYP
2.44 MAX.
CLEARANCE FOR NO. 8-32 HARDWARE
COVER HARDWARE NO.8 SOCKET HD CAP SCREW .75 LONG MS16997-340R EQUIV. STRENGTH W/ NO.8 (.304 O.D.) FLAT WASHER (3 REQD)
SERIAL NUMBER LOCATION
MIRROR SURFACE
CONNECTOR ASSY HARDWARE NO. 6-32 FIL HD X .25 LG (3 REQD)
KEYWAY POSITION
ELECTRICAL INDUSTRIES NO. 125SF/90W-RP-0511 HEADER MATES WITH AMPHENOL NO. 78-S11
SAMPLE FLOW
SAMPLE FLOW
1/8-27 NPT BOTH ENDS
"O" RING
"O" RING
SPECIFICATIONS:
SAMPLE FLOW: 0.5 TO 5 SCFH
DEW POINT RANGE: THE MAXIMUM DEWPOINT DEPRESSION IS 100°F FROM AMBIENT OF 80°F THIS MAXIMUM DEPRESSION DECREASES 1°F FOR EACH 3°F BELOW 80°F
AMBIENT TEMPERATURE: OPERATING -40°F TO 160°F STORAGE -100°F TO +200°F
SAMPLE PRESSURE: 2 PSIA TO 200 PSIA 0 PSIA TO 200 PSIA
MAXIMUM COOLER CURRENT: 3 AMP
READOUT: THERMISTOR 1K AT 25°C
MAXIMUM LAMP CURRENT: 1.2 MA
HEAT SINK: THE AMBIENT SINK TEMPERATURE IS MAINTAINED VIA THE MOUNTING FLANGE
PROOF PRESSURE: 300 PSIA
CALCULATED BURST PRESSURE: 400 PSIA
2.38
1.19
.185/.191 DIA THRU 4 HOLES
2.38
1.19
1.81/1.84 DIA. THRU
RECOMMENDED MATING MOUNTING DIMENSIONS TOL. ±.01
P1
THERMOELECTRIC COOLER
THERMISTOR
PHOTO RESISTOR
LED
5
6
9
10
7
8
3
2
11
4
1
SENSOR SCHEMATIC
QTY REQD | PART OR IDENT NO. | DESCRIPTION | ITEM NO.
PARTS LIST
REMOVE BURRS, BREAK ALL SHARP EDGES .005 MAX
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES. SURF. ROUGHNESS .XX ±.01 EXCEPT .XXX ± AS ANGLES ± NOTED
MATL
FINISH
DR 4 MAR 70
CHK
APPD C. Francisco 1 Apr 70
APPD F.W.D. 3-30-70
APPD 4-6-70
MOD
C13681 | 880-S2
NEXT ASSY | USED ON
APPLICATION
EG&G CAMBRIDGE SYSTEMS OPERATION NEWTON MASSACHUSETTS
CONTROL DWG
DEWPOINT SENSOR ASSY
(MODEL 880-S2)
SIZE C | CODE IDENT NO. 22905 | 13679 | REV B
SCALE 1/1 | SHEET 1 OF 1

Figure 4. Dew Point Sensor Assembly, 880-S2 Control Drawing.

All the sensor electrical connections are provided with an 11-pin connector configuration. In remote applications, the cable is provided with the remote kit.

2.3 PNEUMATIC INSTALLATION

The sensor gas sampling connections, while not intricate, often result in measurement difficulty when leaks and contamination problems exist. The Model 880 generally reads the dew point of the sample present in the sensor but contamination in the sample can result in indicated errors. Sample lines are connected by means of the 1/8 NPT sample ports at the sensor. Only clean lines which are non-hygroscopic and are free of leaks should be used. Stainless steel tube, copper tube or polypropylene tube of 1/8 in., or 1/4 in., in diameter can be used. The lines may be cleaned with Freon or Chlorothene. The use of valves, regulators, or numerous fittings should be avoided and when regulating valves, pumps or flow gauges are used, they should be located on the exhaust side of the system but not between the sample and the sensor, if possible. The proper flow rate is between 0.5 SCFH and 5 SCFH and the sensor is insensitive to flow direction. In most applications it is most desirable to utilize a sampling system in which the pressure at the sensor is the same as the pressure at the desired point of measurement. Pressure changes in the sampling system are accompanied by dew point changes and must be taken into account during data interpretation. Where sample lines or components might be below the anticipated sample dew point temperatures, condensation may occur in the system resulting in errors. In this event, heated lines and components must be used. Gases containing particulate matter should be filtered as close to the sampling point as feasible. Gases containing vapors (other than water) at concentrations which will cause them to condense at temperatures above the dew point cannot, generally, be measured satisfactorily.

In some applications where the ambient dew point is being measured, the sample can be provided by local air circulation if the sensor cover is removed. In these applications avoid the possibility of shining bright light into the sample area. In the absence of any air motion at all, such a mode of operation is not considered very satisfactory.

SECTION 3
OPERATION

3.1 OPERATING PROCEDURE

To assure proper operation of the Model 880 refer to Figure 1 and Figure 5, Rear View of the Model 880 Dew Point Hygrometer, before attempting the standard operating procedure, described in the following paragraph.

1. Locate the Model 880 in a clean area, free of vibration and with free air circulation for convection cooling.
2. Connect the sensor to the air sample via the air intake port (Figure 3) with cleaned, non-hygroscopic, leak-free connections and provide a flow rate of about 2 SCFH.
3. Connect the power cable to a 115V, 60 Hz power source (230V when modified internally).
4. Place the rear METER (Figure 5) switch in the DEW POINT position.
5. Place the front panel control switch (Figure 1) to the TEST position.
6. After switching to the TEST position, allow the meter pointer to move toward the center scale position as the mirror's water or frost film evaporates. When the meter pointer is at a maximum and appears to stop, adjust the BALANCE knob* for a center scale reading (at the diamond below the words DEW POINT). If a balance condition cannot be achieved, clean the mirror (para 6.2) and repeat Steps 4, 5 and 6. If the balance condition is still unattainable, adjust the internal SEN CAL adjustment (para 6.2(5) and proceed with Step 7**.

*Adjust BALANCE knob within one minute after the pointer reaches a maximum and appears stable, otherwise the pointer may begin to drift up or down as the Sensor electro-optical components heat while in the TEST position.

**When the 880-SU Selector Unit is used, all balancing is performed at the Selector Unit per instructions in the 880-SU Manual.

NORMAL OPERATION
1. READ INSTRUCTION MANUAL
2. PLACE THE SWITCH IN TEST POSITION
3. WHEN POINTER REACHES STABLE MAXIMUM INDICATION (ALLOW 10 SEC)
SET BALANCE FOR POINTER INDICATION AT DIAMOND
4. PLACE SWITCH IN OPERATE. COOLING LAMP WILL BE BRIGHT AS MIRROR
COOLS TO DEW POINT AND WILL DIM WHEN DEW POINT IS REACHED
MANUFACTURED UNDER
U.S. PATENTS 3,195,344 & 3,195,345. FOREIGN PATENTS PENDING
METER
DEW POINT
REMOTE THERMISTOR
EG&G
WALTHAM MASS 02154
ENVIRONMENTAL EQUIPMENT DIV
MODEL 880 C1
SERIAL 1447
RECORD OUTPUT
REMOTE THERMISTOR
GND

Figure 5. Rear View of the Model 880 Dew Point Hygrometer.

7. Turn the front panel switch to the OPR position. The COOLING lamp should increase to maximum brightness* and the front panel meter will now display the mirror temperature. The temperature will initially indicate above the ambient temperature and then drop to below the dew point of the gas sample. At this point condensate will form on the mirror surface, inside the sensor, causing a reduction in intensity of the cooling lamp and a decrease in the cooling rate of the mirror. In a short time the indicated temperature will stabilize at the sample dew point. When this occurs the cooling lamp intensity will depend on the dew point depression, dim for low depression and bright for maximum depression. The dew point depression is the difference in temperature between the ambient temperature and the dew point temperature of the sample. Sudden changes in the sample dew point will cause a fluctuation in the lamp intensity followed by a change in the indicated dew point reading. A constant fluctuation of the lamp intensity is indicative of control-loop oscillation and may occur at high sample flow-rates or at high gain settings (an internal instrument adjustment). The constant fluctuation is not detrimental to good readings when the dew point temperature indication is steady.

8. In the event that the air sample is very dry and the dew point is below the capability of the instrument, the COOLING lamp will remain at maximum intensity indicating that the temperature is slowly approaching a minimum reading. If it is desirable to determine the hygrometer's lowest temperature capabilities, an unmarked (fourth) position is provided on the front panel switch beyond the OPR position. When the control switch is in the unmarked position the instrument will constantly cool to maximum capability. However, when in this position, if the sample is of a high dew point, excessive condensate will tend to collect and it will take a long time with the control switch in the TEST position, to remove all the condensate.

*Momentarily switch to unmarked position beyond OPR position to determine appearance of lamp at maximum brightness.

3.2 PRINCIPLE OF OPERATION

The Model 880 Dew Point Hygrometer is an automatic, optically sensed, thermoelectrically cooled, condensation dew-point hygrometer. It measures the dew point of a gas sample by the primary defining technique; namely it presents a cooled metal surface to the gas sample so that the temperature of the gas at the metal surface is at the temperature of the metal. When the temperature of the surface is cooled below the dew point of the gas, condensation occurs and water in the form of droplets or ice crystals (depending on the temperature) will form on the surface. If the surface is maintained at a temperature below the dew point (however slight this temperature difference might be) condensation will continue and result in an increasing amount of water on the surface. If the surface is at a temperature above the dew point temperature, then the water on the surface will start to evaporate resulting in a reduction in the amount of water on the surface. Only when the surface temperature is exactly at the dew point temperature will a state of dynamic equilibrium exist, i.e., where the rate at which molecules leave the water surface is equal to the rate at which water molecules enter the water surface from the surrounding gas. In this condition, the amount of water on the metal surface is unchanging and at this point, the metal surface is exactly at the dew point temperature.

Within the instrument the metal surface (in contact with the gas sample) is a copper disc about 1/4-in. in diameter, with a highly polished surface (mirror) which is heavily gold plated to render it inert. The temperature of the surface is measured by means of an embedded precision thermistor which, in turn, forms a part of an electrical bridge circuit. The circuit tends to linearize the thermistor characteristic and the output is displayed as degrees Fahrenheit or Centigrade on the front panel meter. A 0 to 50 mV output proportional to the meter deflection is also available from the bridge circuit located on the rear panel.

The presence of condensate on the sensor mirror surface is detected via an optical system. An LED light source in the sensor directs light to the mirror surface where it is reflected at an angle to intersect a photoconductive cell. The resistance of the photoconductive

cell, which changes in relation to the amount of light striking it, forms part of a bridge circuit where the electrical output is indicative of the reflectance of the mirror surface. The photoconductive bridge output is amplified and directed to a thermoelectric element which, in turn, is bonded to the base of the mirror in the sensor. The thermoelectric element has two surfaces, one of which can be made cool by rejecting heat through the other surface upon the application of an electric current. This optical-thermal feedback control system is a servomechanism which adjusts and maintains the mirror surface to the temperature which results in a constant reduction in reflectance. This, then, requires a constant amount of condensate which is only achieved, precisely, at the dew point temperature. The circuit is adjusted via the BALANCE control where a maximum amount of cooling occurs when the mirror is free of condensate. As condensate forms, however, the cooling effect is proportionately decreased until equilibrium exists, where a constant amount of condensate results in the correct cooling to maintain the mirror at the dew point temperature. It is useful, at this time, to consider the effects of contaminants on the mirror surface. Insoluble contaminants such as dust or dirt will also reduce the amount of light to the photoconductor just as does the condensate. The effect of the insoluble contaminant does not vary with the temperature, however, so that it does not result in a readout error but it does limit the amount of cooling provided to the sensor. The insoluble contaminant has the same effect as improperly balancing the hygrometer and can be compensated by rebalancing the hygrometer. During the balance procedure the meter registering anywhere on the balance line (below the words DEW POINT on the front panel) will result in a correct reading. Eventually, however, if enough contamination accumulates it will obstruct the light to the extent that the instrument will be inoperative unless the sensor is cleaned.

Soluble contaminants, such as salts or acids, will change the temperature at which equilibrium occurs. Water is in equilibrium with the vapor in the gas, when at the dew point temperature. However, a solution of water with a solute is in equilibrium with the vapor in the gas, at a temperature slightly higher than the dew point temperature, depending on the concentration, which results in an up-scale drift of the temperature indication. Thus, these contaminants must be avoided or removed when they are present.

SECTION 4
CIRCUIT DESCRIPTION

4.1 INTRODUCTION

A typical schematic is shown in Section 6, with the description and identification of the components, located at the end of the manual while the sensor assembly is as presented in Figures 3 and 4. The circuit is completely solid-state requiring essentially no warm-up time.

4.2 SENSOR CIRCUIT

The sensor contains four solid-state elements, the thermoelectric cooler, the sensing thermistor, the LED light source, and the photoresistor. Each element is individually connected to the terminals with a pair of leads making the electrical checkout of the sensor an easy matter. The sensor is not considered a repairable item since all the components are potted in place.

4.3 CONTROL CIRCUIT

The control circuit is assembled on a printed-circuit board with a wiring harness connecting the remaining components.

4.3.1 Power Supply

There are two power supplies fed by a single transformer (T1) which is connected at the primary for a 115V, 50 to 70 Hz operation and can be changed by the user to operate from 230 volts by moving the lead from Terminal No. 2 (on the transformer, T1) to Terminal No. 3. The low-voltage, high current supply is fed from the transformer Terminal Nos. 6, 7 and 8. Rectifiers CR1 and CR2 provide up to a 9-V dc power supply across capacitor C1 (less at full load). The power supply provides up to 3 amperes to the thermoelectric cooler via transistor, Q1. The high-voltage, low current supply is fed from Terminal No. 4 and No. 5 of the transformer (T1) through the bridge rectifier to provide 115V, dc at the capacitor, C1. The 115V, dc supply also provides

power to the remainder of the circuit by means of the 9-volt regulating diode, CR1, while the cooler drive voltage present at the terminals of capacitor C1 on the chassis provides power for the LED driver current regulator.

4.3.2 Amplifier

The transistor, Q2, is a difference amplifier fed by the photoresistor in the sensor at one input and a variable voltage divider at the other. The output of Q2 feeds emitter-follower Q3, which in turn feeds the cooler driver. Transistor Q4 is used to control the cooling lamp intensity.

4.3.3 Temperature Readout

The temperature readout is a bridge circuit fed by the regulated 9-volt supply, with the thermistor in one arm of the bridge. The bridge contains zero and span controls as well as an output calibration which is in series with the meter readout.

SECTION 5
INTERPRETATION OF DATA

5.1 DESCRIPTION

The temperature display indicates the temperature of the mirror surface, in the sensor, when the rear panel switch is in the DEW POINT position and the front panel switch is in the OPR position. Under the above stated conditions the mirror surface may, or may not, be at the true dew point temperature. The temperature reading is likely to be correct when the answer to the following questions is affirmative.

1. Is the gas sample in the sensor uncontaminated and representative of the gas to be measured?
2. Is the flow rate between 0.5 SCFH and 5 SCFH?
3. Is the dew point of the gas within the measuring range of the instrument with regard to temperature and depression requirements?
4. Does the hygrometer meter pointer return to the balance point (center scale) when placed in the TEST position?
5. Does the hygrometer exhibit the proper dynamic behavior when switched from the TEST to the OPR position?
6. For a constant sample, does the hygrometer repeat the reading after balancing in the TEST position and returning to the OPR position?
7. Is the water vapor dew point the highest dew point in the measured gas? (Occasionally, a higher dew point of another vapor constituent exists and the instrument will measure this higher dew point. High hydrocarbon dew points are often encountered.)

With reference to Question 5, the proper dynamic behavior is as follows. After switching to the TEST position, enough time is allowed to let the water film evaporate from the mirror surface. This will be indicated by the movement of the meter pointer toward the center scale position. When the pointer position is maximum and stable (for about one minute), the BALANCE knob is adjusted for a center scale reading. Then, the front panel control switch is placed in the OPR position whereupon the COOLING

lamp will increase to maximum intensity and the temperature indication on the meter will show a decreasing mirror temperature. When the mirror reaches the dew point temperature it continues to cool slightly below this temperature (overshoots by 2°F to 5°F). At this point, the COOLING lamp will decrease in intensity and the indicated mirror temperature will rise and settle on a stable reading of the dew point. The amount of overshoot and the amount of time required to settle on the correct dew point reading will vary from 1°F or 2°F and about 10 seconds, at high dew points and high flow rates; to 10°F or 20°F and, up to 10 minutes, at the lowest dew points and low flow rates. Under certain conditions the control system will oscillate at a rate of several seconds per cycle. This can occur at high dew points and high flow rates. If the deviation of the mirror temperature is one or two degrees, no action need be taken and the temperature can be averaged. The oscillation can usually be eliminated by reduction of the sample flow rate. In some cases, the internal dew thickness (THK) setting or the GAIN setting may have to be reduced.

5.2 READINGS BELOW 32°F

At mirror temperatures below 32°F the water on the mirror surface can be ice or can be super-cooled liquid. Generally, it is in the form of super-cooled liquid for a short time, i.e., when the temperature is not far below the freezing point, but, eventually, it transits to the ice state. This fact is significant because, for a given gas sample with fixed water vapor content, the temperature at which a surface of ice must be maintained to be in equilibrium with the water vapor is slightly higher than that for water. Presented in Table 1, the Frost Point to Dew Point Conversion is the relationship between the frost point and the dew point readings for equivalent gas moisture.

Table 1. Frost Point to Dew Point Conversion

Below 32°F, dew point hygrometers measure the frost point temperature rather than the dew point. The following table permits conversion from dew to frost point. For a more accurate conversion, consult Table 102, located on page 371 of "Smithsonian Meteorological Tables."

F.P.	D.P.	F.P.	D.P.
+32	+32	-11	-15.6
+31	+30.8	-12	-16.7
+30	+29.7	-13	-17.8
+29	+28.6	-14	-18.9
+28	+27.5	-15	-20.0
+27	+26.4	-16	-21.1
+26	+25.2	-17	-22.2
+25	+24.1	-18	-23.3
+24	+22.9	-19	-24.3
+23	+21.8	-20	-25.4
+22	+20.7	-21	-26.4
+21	+19.6	-22	-27.5
+20	+18.5	-23	-28.6
+19	+17.4	-24	-29.6
+18	+16.2	-25	-30.6
+17	+15.1	-26	-31.7
+16	+14.0	-27	-32.8
+15	+12.9	-28	-33.9
+14	+11.8	-29	-35.0
+13	+10.7	-30	-36.1
+12	+ 9.6	-31	-37.2
+11	+ 8.5	-32	-38.2
+10	+ 7.4	-33	-39.3
+ 9	+ 6.3	-34	-40.3
+ 8	+ 5.2	-35	-41.4
+ 7	+ 4.1	-36	-42.4
+ 6	+ 2.9	-37	-43.5
+ 5	+ 1.8	-38	-44.5
+ 4	+ 0.7	-39	-45.6
+ 3	- 0.4	-40	-46.6
+ 2	- 1.5	-41	-47.7
+ 1	- 2.6	-42	-48.7
0	- 3.7	-43	-49.8
- 1	- 4.8	-44	-50.8
- 2	- 5.8	-45	-51.9
- 3	- 6.9	-46	-52.9
- 4	- 8.0	-47	-54.0
- 5	- 9.1	-48	-55.0
- 6	-10.2	-49	-56.1
- 7	-11.3	-50	-57.1
- 8	-12.4	-51	-58.2
- 9	-13.5	-52	-59.2
-10	-14.6	-53	-60.3

5.3 READINGS AT DIFFERING PRESSURES

In a gas system where the sample goes through a pressure change and, provided there is no condensation due to the change, the change in water vapor pressure is proportional to the total pressure change and can be calculated from Dalton's law accordingly.

$$e_2 = e_1 \frac{P_2}{P_1}$$

where e_2 is the partial pressure of water vapor at the total pressure and P_2 and P_1 is the partial pressure of water vapor at the total pressure P_1. There is a one-for-one correspondence between the partial pressure of water vapor (e) and the dew point temperature. (Smithsonian Meteorological Tables by list.)

A useful approximation is

$$\Delta TD = 14 \frac{\Delta P}{P}$$

where Δ TD is the change in dew point temperature (^{o}C) due to a change in sample pressure, ΔP is the change in sample pressure, and P is the sample pressure. Thus, a 10% change in pressure ($\frac{\Delta P}{P} = -\frac{1}{10}$) will result in about -1.4^{o}C change in the dew point temperature.

5.4 RECORDER OUTPUT

The electrical output at the rear terminals is the voltage drop across a resistance of about 1000 Ohms in series with the panel meter. Thus, the voltage is proportional to the meter deflection of 0 mV at -40^{o}C and +50 mV at +50^{o}C. The meter scale is not linear however. The relationship is as shown in Figure 6, Temperature vs Percentage Output. The output voltage is present at the rear terminals in the OPR and cool positions (located on the front panel control switch) but is not present in the TEST position. The output voltage at the full scale meter reading is 50 mV but can be adjusted $\pm$ 20% by means of the internal adjustment output calibration. It is desirable to use a high impedance recorder such as a null balance servo-type but recorder impedance as low as 10K-Ohms can be compensated by the output calibration adjustment.

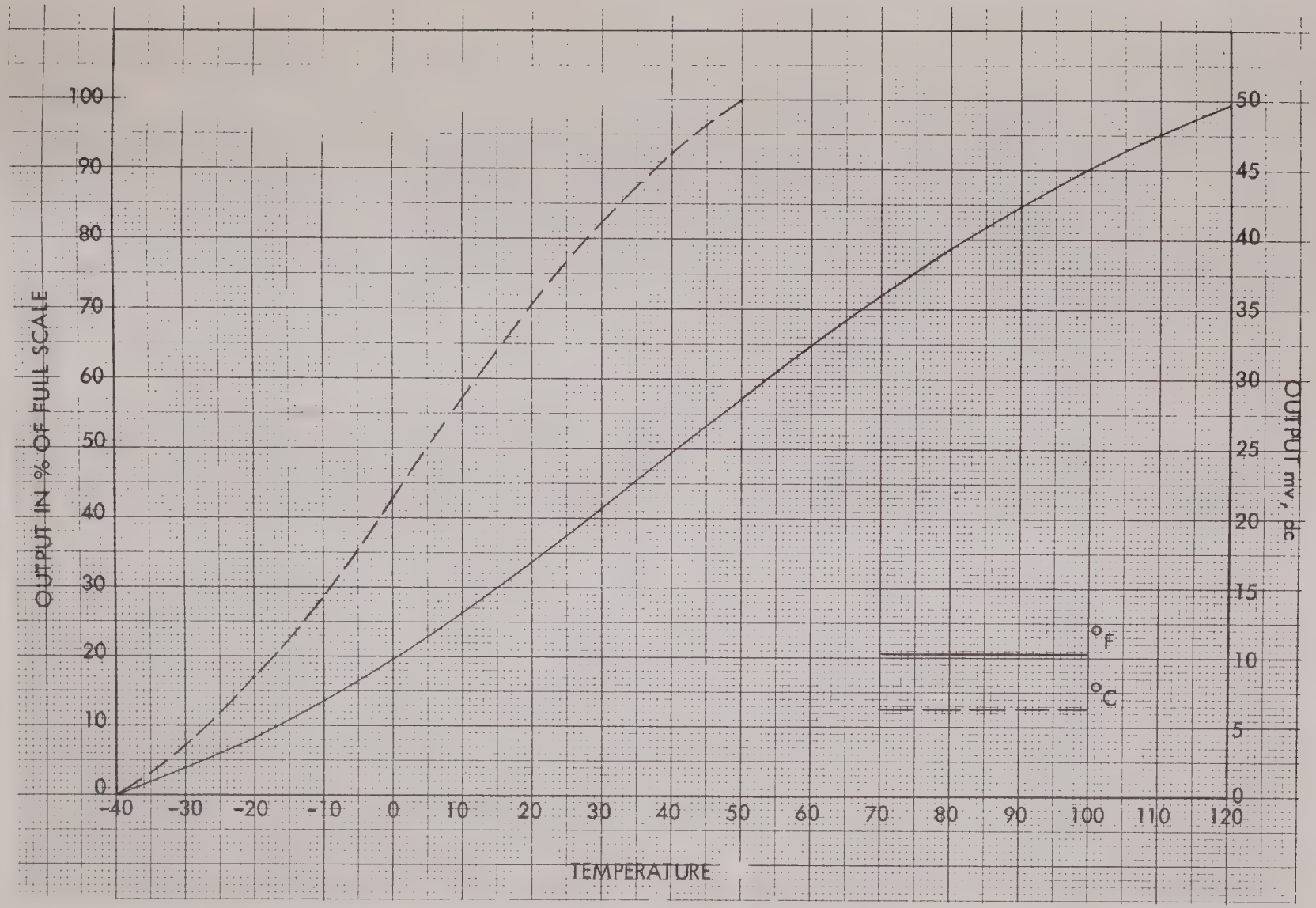


Figure 6. Temperature vs Percentage Output

SECTION 6
MAINTENANCE

6.1 INTRODUCTION

Little maintenance is required due to the solid-state, printed circuit construction. The only components requiring periodic maintenance are the sensor and the associated sampling system.

6.2 PERIODIC MAINTENANCE

The sensor incorporates optical sensing devices as shown in Figure 7, the 880-S Optical Configuration, and must, therefore, be maintained at some minimum level of cleanliness. The frequency of sensor cleaning required for proper maintenance will vary widely with sampling conditions. Cleaning the sensor can usually be ignored until an excessive balance shift or the inability to adjust the meter pointer back to the balance point makes cleaning the sensor a necessity. In some cases the accumulation of soluble materials will result in high readings and the sensor should be cleaned more often. In the event that the sample is excessively dirty, the entire sample line and sensor should be cleaned and a filter (typically 5 to 10 micron) installed at the input to the sample line. In many installations the sensor will require cleaning every 1000 to 2000 hours of operation. The presence of contamination on the mirror surface is evidenced by the fact that the meter pointer falls short of returning to the center balance position when the front panel control switch is placed in the TEST position and the moisture has evaporated. A small shift is of no concern, however, and may be compensated by adjustment of the BALANCE control by turning it in a clockwise direction. When the contamination interferes with instrument operation or the BALANCE control is at the end of its range, clean the sensor as follows:

1. Remove the three sensor cover rim-screws and carefully draw the cover back and away from the sensor exposing the sensor configuration (as shown in Figure 7).

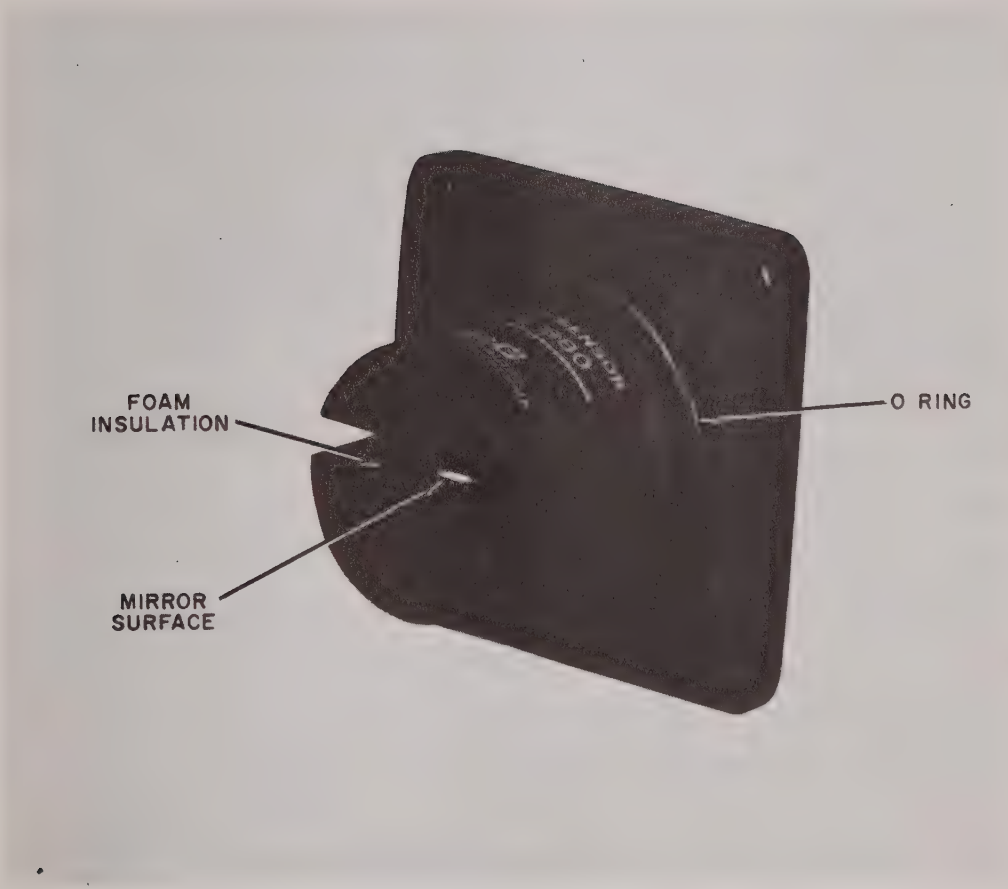


Figure 7. 880-S Optical Configuration.

2. If the inside of the sensor cover and the outer metal portions of the sensor are soiled, clean with alcohol or chlorothene.
3. Clean the gold plated mirror surface (shown in Figure 7) using a cotton-tip applicator dampened with a very small amount of EG&G, Type A Cleaner. If the Type A Cleaner is not available, isopropyl alcohol may be used. Clean the light parts above the mirror and lightly buff the mirror with a dry, clean applicator. Avoid scratching the mirror surface. The black material surrounding the mirror is a plastic foam insulating material which is soft and subject to damage under careless use and excessive use of cleaner.
4. Reassemble the sensor after inspecting the O-ring and the O-ring seal to be certain of achieving a gas-tight seal. Test for leaks if necessary after replacing the cover.
5. Place the instrument into operation following the operating instructions as described in Section 3, with the following exception when necessary. After cleaning or changing sensors reset SEN CAL positioned on the printed circuit board as shown in Figure 8, Component Board Adjustment Location, inside the instrument as follows:
    a. In Step 6 of the operating procedure (para 3.1) set the BALANCE knob fully counterclockwise. (Function switch in TEST position.)
    b. Set the SEN CAL so that the meter reads at the center of the scale (center of the balance line).
    c. Proceed to Step 7 of the operating procedure.

6.3 TEMPERATURE CALIBRATION

The temperature bridge circuit is calibrated prior to shipment and should not need calibration unless a component is changed. Referring to Figure 8, the calibration procedure is as follows:

1. With the power off, adjust the mechanical zero of the temperature readout meter to read -40°C.

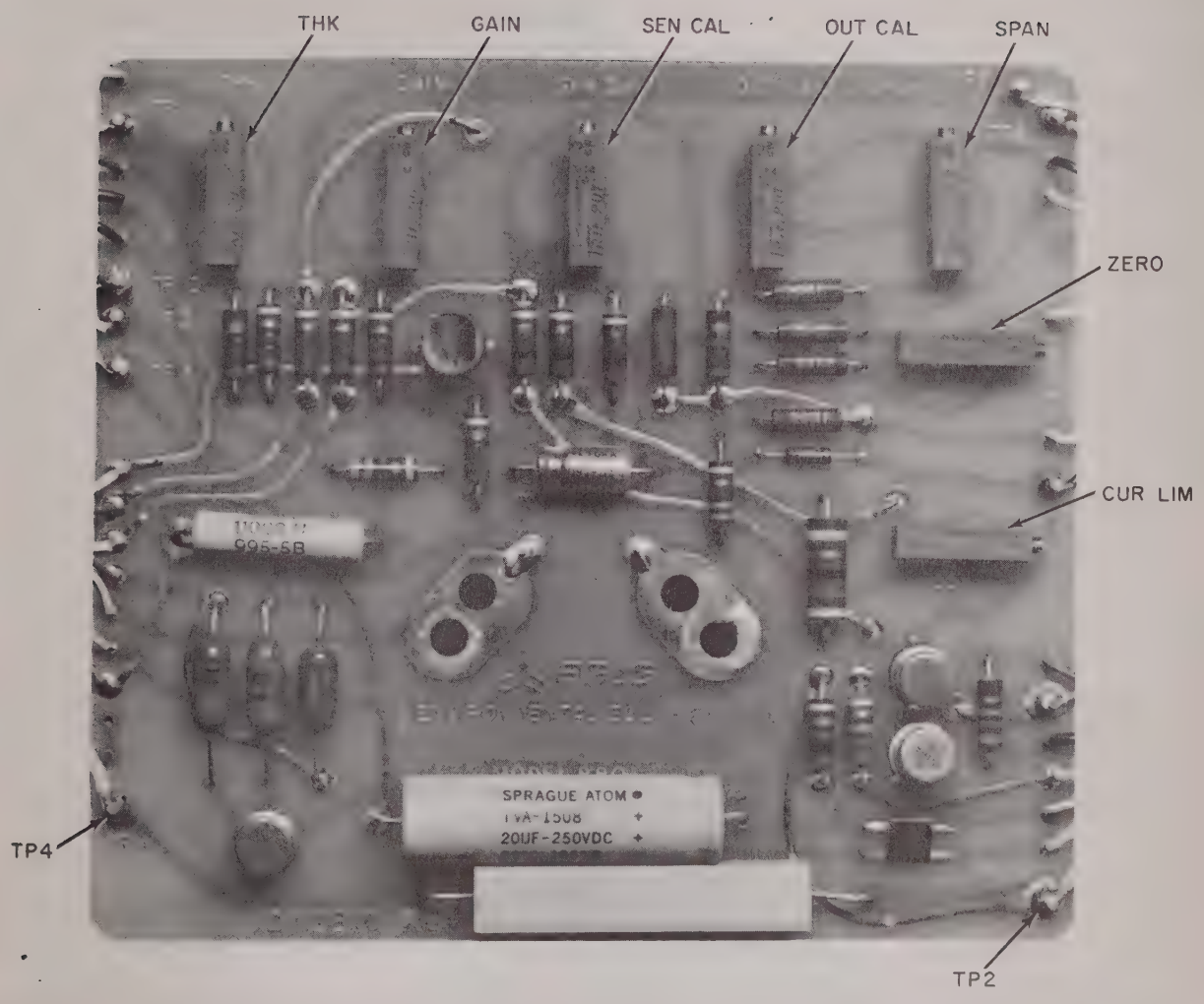


Figure 8. Component Board, Adjustment Location.

NOTE

Use the 880 meter anti-parallax mirror when reading the meter.

2. Connect a precision resistor of 18550 ohms, ±0.1% (or a decade resistance box at this value) to the REMOTE THERMISTOR terminals at the rear of the hygrometer and place the METER switch in the REMOTE THERMISTOR position.
3. Place the front panel function switch in the OPR position and with the hygrometer top cover removed, adjust ZERO to result in a reading of -40°C on the temperature readout.
4. CENTIGRADE Calibration: Connect a precision resistance of 423.9 ohms ±0.1% to the REMOTE THERMISTOR terminals and adjust SPAN to result in a reading of +50°C. The recorder output may be adjusted to 50 mV at this time with the OUT CAL if desired.

   FAHRENHEIT Calibration: Connect a precision resistance of 439.4 ohms ± 0.1% to the REMOTE THERMISTOR terminals and adjust SPAN to result in a reading of +120°F. The recorder output may be adjusted to 50 mV at this time with the OUT CAL pot if desired.
5. The end points may be rechecked.
6. Points on the Fahrenheit scale may be checked through the use of the resistance values in Table 2, Temperature vs Resistance Characteristics.

6.4 HYGROMETER INTERNAL ADJUSTMENTS

The internal hygrometer adjustments are factory aligned and generally need not be readjusted unless a component has been changed. The adjustments may be divided into two groups: those adjustments having to do with the temperature circuit, ZERO, SPAN and OUT CAL which have been described in para 6.3 and those adjustments having to do with the hygrometer control circuit, CUR LIM, THK, GAIN and SEN CAL.

The CUR LIM control is used to set the maximum current delivered to the cooler in the sensor. It must be remembered that a setting too low will result in inadequate depression capability.

SEN CAL balances the photocell bridge circuit and the result is, essentially, the same as a coarse adjustment for the BALANCE control on the front panel.

The GAIN control sets the gain in the hygrometer control circuit. Excessive gain can cause oscillation while insufficient gain will result in sluggish operation or loss of adjustment sensitivity of the front panel BALANCE adjustment.

The THK adjustment sets the light level reduction from the mirror which is required to start cutting off the cooler current; thus it sets the dew layer thickness during normal operation.

6.5 ADJUSTMENT PROCEDURE

1. To set the internal adjustments, start with a clean sensor (see paragraph 6.2(1-4)) and aspirate with room air. Place the front panel BALANCE control to the fully CCW position.
2. Remove the cover from the control unit and place a digital voltmeter, set to read a voltage in the vicinity of 500 mvdc, across terminals TP2 and TP4 on the component PC board. Refer to Figure 8 or drawing D12811 (Figure 10, in the rear of the manual) for location of terminals.
3. To set the CUR LIM, place the front panel control switch to the unmarked, cool position to the right of the OPR position and adjust CUR LIM for a reading of 500 mvdc ±5 mvdc on the digital voltmeter. The 880 COOLING lamp must be brightly lit. Return the front panel control switch to the TEST position as soon as possible after making the adjustment.
4. Short the THK pot out by connecting a short jumper from TP1 to E12 (located just above TP1 - refer to Figure 10).

5. With the front panel control switch at the TEST position, adjust the SEN CAL pot so that the meter indicates center scale.

NOTE

Do not leave the 880 control switch in the TEST position for more than 5 minutes. If the control switch has been in the TEST position for 5 minutes, set it to OPR for 2 minutes before returning to the TEST position.

6. Set the control switch to OPR. Immediately read the digital voltmeter and adjust the GAIN pot so that the digital voltmeter reads 300 ±10 mvdc. This adjustment must be made shortly after setting the control switch to OPR as the digital voltmeter reading will drop with time. Return the switch to TEST as soon as the adjustment is made.
7. Allow the 880 DEW POINT meter to stabilize at TEST (about 1 minute). Check that the meter is balanced. Readjust the SEN CAL pot slightly if necessary.
8. Remove the jumper installed in step 4.
9. Set the control switch to OPR. Immediately read the digital voltmeter and adjust the THK pot so that the digital voltmeter reads 450 ±10 mvdc. This adjustment must be made shortly after setting the control switch to OPR as the digital voltmeter reading will drop with time.
10. After the THK pot has been adjusted, observe the 880 DEW POINT meter reading. The reading must drop smoothly then stabilize with less than 3°C overshoot (if aspirating with room air. Samples with very low dew points may cause an overshoot of 10°C or more). After 2 minutes, DEW POINT meter reading must not fluctuate.

11. If the meter overshoot exceeds 3°C or fluctuates, the system is oscillating. Oscillation may also be indicated by periodic brightening and dimming of the COOLING lamp. Oscillation can be caused by excessive gain or excessively high sample flow rate. Try reducing the sample flow rate.

TEMPERATURE vs
RESISTANCE
CHARACTERISTIC

Table 2. Temperature vs Resistance Characteristic.

Temp °F	R(ohms)	Temp °F	R(ohms)	Temp °F	R(ohms)
-100	143,300	+2	5,676	102	611.6
-98	132,800	4	5,387	104	589.0
-96	123,200	6	5,115	106	567.4
-94	114,300	8	4,858	108	546.7
-92	106,100	10	4,617	110	526.9
-90	98,580	12	4,388	112	507.9
-88	91,650	14	4,172	114	489.7
-86	85,250	16	3,968	116	472.2
-84	79,220	18	3,776	118	455.4
-82	73,850	20	3,594	120	439.4
-80	68,800	22	3,422	122	423.9
-78	64,100	24	3,260	124	409.2
-76	59,770	26	3,106	126	395.0
-74	55,780	28	2,960	128	381.4
-72	52,080	30	2,822	130	368.4
-70	48,650	32	2,691	132	355.9
-68	45,470	34	2,567	134	343.9
-66	42,510	36	2,449	136	332.3
-64	39,770	38	2,338	138	321.2
-62	37,220	40	2,232	140	310.5
-60	34,850	42	2,133	142	300.2
-58	32,640	44	2,037	144	290.4
-56	30,610	46	1,946	146	280.9
-54	28,700	48	1,860	148	271.7
-52	26,930	50	1,779	150	263.0
-50	25,280	52	1,702	152	254.5
-48	23,750	54	1,628	154	246.4
-46	22,310	56	1,558	156	238.6
-44	20,960	58	1,492	158	231.0
-42	19,710	60	1,428	160	223.8
-40	18,550	62	1,369	162	216.8
-38	17,460	64	1,311	164	210.0
-36	16,450	66	1,256	166	203.6
-34	15,490	68	1,204	168	197.3
-32	14,600	70	1,155	170	191.3
-30	13,760	72	1,108	172	185.5
-28	12,990	74	1,063	174	179.9
-26	12,250	76	1,021	176	174.5
-24	11,570	78	979.7	178	169.3
-22	10,920	80	940.4	180	164.2
-20	10,323	82	903.2	182	159.4
-18	9,758	84	867.5	184	154.7
-16	9,228	86	833.7	186	150.2
-14	8,730	88	801.4	188	145.8
-12	8,261	90	770.6	190	141.6
-10	7,821	92	741.0	192	137.5
-8	7,407	94	712.8	194	133.6
-6	7,017	96	685.8	196	129.8
-4	6,649	98	660.0	198	126.1
-2	6,305	100	635.3	200	122.6
0	5,981				

SECTION 7
PARTS LIST

The electrical parts list provides the description and identification of the components applicable to the Model 880 instrumentation with the reference designations corresponding to Figure 9, the Model 880 Dew Point Hygrometer, electrical schematic. If component replacement is necessary, replacement should be made in accordance with Table 3, the Component Assembly, Electrical Parts List and Table 4, the Control Unit, Electrical Parts List.

7.1 ORDERING INFORMATION

Orders for replacement parts should be addressed as follows:

Marketing Department
EG&G International, Inc.
Environmental Equipment Division
151 Bear Hill Road
Waltham, Massachusetts 02154

When ordering by telephone call: (617) 890-3710
TELEX is: 92-3429

The following information should be supplied when ordering:

1. Part Number
2. Part Description
3. Manufacturer, if known
4. Model Number
5. Serial Number

The Model and Serial numbers are located on an identification plate on the back of the instrument.

Table 3. The 880-C1 Component Board Assembly (D12811), Electrical Parts List

REF DES	PART DESCRIPTION	MANUF IDENT.	MANUF PART NO.
A1	Rectifier Assembly	Motorola	MDA-920A-4
C1	Capacitor, Electrolytic, 20 μF, 250V, dc	Sprague	TVA-1508
C2	Capacitor, Electrolytic, 10 μF, 15V, dc	Sprague	TE-1155
CR1	Diode, Zener	Motorola	1N935
Q1	Transistor	RCA	2N398A
Q2	Transistor, Dual	Sprague	TD 101
Q3	Transistor	RCA	2N3053
Q4	Same as Q3		
R1	Resistor, Comp, 36K, 1/2W, ±5%		RC20GF363J
R2	Resistor, Comp, 6.8K, 1/2W, ±5%		RC20GF682J
R3	Resistor, Film, 6040 Ω, 1/8W, ±1%		RN60C6041F
R4	Resistor, Film, 2670 Ω, 1/8W, ±1%		RN60C2671F
R5	Resistor, Variable, 20K, ±20%	Bourns	3006P-1-203
R6	Resistor, Comp, 330 Ω, 1/2W, ±5%		RC20GF331J
R7	Resistor, Comp, 1000 Ω, 1/2W, ±5%		RC20GF102J
R8	Resistor, Comp, 2.2K, 1/2W, ±5%		RC20GF222J
R9	Same as R7		
R10	Resistor, Comp, 1.2K, 1/2W, ±5%		RC20GF122J
R11	Resistor, Variable, 2K, ±20%	Bourns	3006P-1-202
R12	Same as R10		
R13	Same as R7		
R14	Resistor, Comp, 820 Ω, 1/2W, ±5%		RC20GF821J

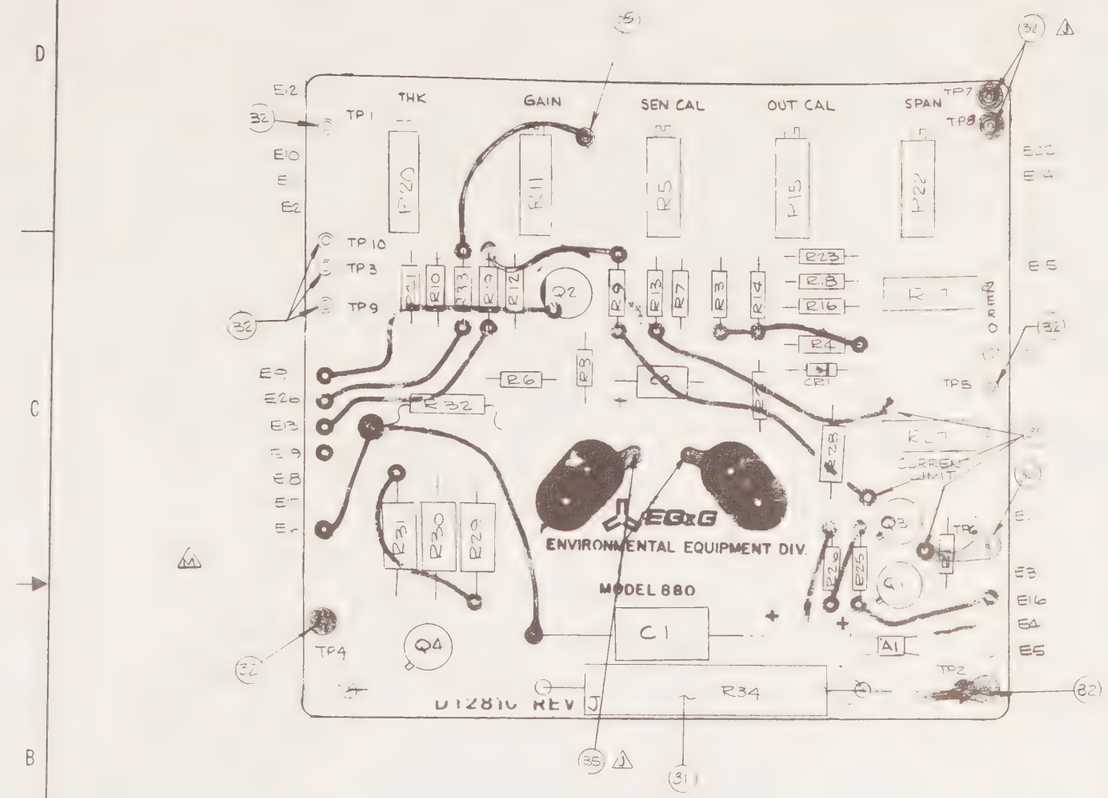
Table 3. The 880-C1 Component Board Assembly (D12811), Electrical Parts List (cont)

REF DES	PART DESCRIPTION	MANUF IDENT.	MANUF PART NO.
R15	Resistor, Variable, 500Ω, ±20%	Bourns	3006P-1-501
R16	Resistor, Film, 8870Ω, 1/8W, ±1%		RN60C8871F
R17	Same as R15		
R18	Resistor, Film, 3090Ω, 1/8W, ±5%		RC60C3091F
R19	Resistor, Comp, 8200Ω, 1/2W, ±5%		RC20GF822J
R20	Resistor, Var. 51K ±20%	Bourns	3006P-1-502
R21	Resistor, Comp, 7.5K, 1/2W, ±5%		RC20GF752J
R22	Same as R5		
R23	Resistor, Film, 30.1K, 1/8W, ±1%		RN60C3012F
R25	Resistor, Comp, 12K, 1/2W, ±5%		RC20GF123J
R26	Resistor, Comp, 100Ω, 1/2W, ±5%		RC20GF101J
R27	Resistor, Variable, 100Ω, ±20%	Bourns	3006P-1-101
R28	Resistor, Comp, 47Ω, 1W, ±5%		RC32GF470J
R29	Resistor, Wire-wound, 68Ω, 3W, ±5%	Sprague	242E6805
R30	Resistor, Wire-wound, 4Ω, 3W, ±5%	Sprague	242E4R05
R31	Same as R30		
R32	Resistor, Wire-wound, 11K, 5W, ±5%	Ohmite	995-5B-4655
R33	Same as R8		
R34	Resistor, Wire-wound, 0.2Ω, 10W, ±10%	Colbar	CW10 with .040 leads

Table 4. The 880-C1 Control Unit (E-12759)
Electrical Parts List

REF DES	PART DESCRIPTION	MANUF IDENT.	MANUF PART NO.
C1	Capacitor, 28K μF, 10V	Sprague	36D283G010BB2A
C2	Capacitor, 100 MFD, 12V	Sprague	TE-1135
CR1	Rectifier	Motorola	1N3208
CR2	Same as CR1		
DS1	Lamp	Leecraft	32R-G1-2314
F1	Fuse, 3/4 amp, 3AG, Slo-Blo	Littelfuse	313.750
M1	Meter, Panel	EG&G	A12646
P1	Cord, Line, Gray Vinyl	Belden	17237
Q1	Transistor	RCA	2N3055
R1	Potentiometer, 2000Ω, 2W	Clarostat	53C3-2000S
R2	Resistor, Power, 5Ω, 10W	Clarostat	VPR10F
S1	Switch, Rotary	EG&G	A12690
S2	Switch, Slide, DPDT	Stackpole	SS-72
T1	Transformer, Power	EG&G	A12603
	Knob, Balance	Kurz-Kasch	S-1745-3L
	Knob, Function	Kurz-Kasch	S-1648-3L
A1	Component Board Assy	EG&G	D-12811
A2	S1 Dew Point Sensor Assy	EG&G	C-12706
	S1 Cover	EG&G	C-12172-1
Accessory	S2 Dew Point Sensor Assy	EG&G	C-13681
Accessory	S2 Cover	EG&G	C-12172-2
	O-Ring for S1 and S2 Sensor	Parker	2-132 BUNA-N
Accessory	880-XC-S2 Sensor Extension Cable (25 ft.)	EG&G	C-12918-1

Figure 9. Dew Point Hygrometer, Model 880, Electrical Schematic, D12803.



NOTES:
1. ASSEMBLE PER
2. MOUNT POWER RESISTORS R29, R30, R31 AND R32 APPROX. .12 OFF BOARD SURFACE.

ZONE	LTR	E.C.O. NO.	DESCRIPTION	DATE	APPROVAL
	U	5465	Rel/ECO RELAYOUT-TAGGED PLG	11/1/76	

ITEM NO.	QTY REQD	PART OR IDENT NO.	DESCRIPTION
46	1	RC07GF752V	RESISTOR, COMP. 7.5K 1/2W ± 5%
45	1	3006P-1-202	RESISTOR, VAR. 2K (BOURNS)
44	REF	PSP-11-6611	ROLLING PUNCH (CAMBION)
43	2	RC20GF122J	RESISTOR, COMP 1200Ω, 1/2W ± 5%
42	REF	D12803	ELECTRICAL SCHEMATIC
41	REF	PSP-54(6654)	PUNCH, FLARING (CAMBION)
40	REF	PSA-30(6430)	ANVIL, SWAGGING (CAMBION)
39	REF	PSP-57(6657)	PUNCH, FLARING (CAMBION)
38	REF	PSA12(6412)	ANVIL, SWAGGING (CAMBION)
37	AR		
36	AR		
35	AR	NO 22	WIRE, BUSS, ELECTRICAL
34	3	7717-5	SEMICONDUCTO MTG. PAD (THERMALLOY)
33	2	1785-2	TERMINAL (CAMBION)
32	10	2000-2	TERMINAL (CAMBION)
31	1	TYPE CW5 LEADS .045 DIA	RESISTOR, 22 Ω ± 10% 5WW (TUNES/DALE/REF)
30	1	1N935	ZENER DIODE (MOT)
29	2	2N3053	TRANSISTOR (RCA)
28	1	TD101	TRANSISTOR, DUAL (SPRAGUE)
27	1	2N398A	TRANSISTOR (RCA)
26	1	TE 1155	CAPACITOR, ELECTROLYTIC, 10 MFD, 5VDC (SPRAGUE)
25	1	TVA-505	CAPACITOR, ELECTROLYTIC, 20 MFD, 250VDC (SPRAGUE)
24	1	MDA-920A-4	RECTIFIER ASSY (MOT)
23	1	995-58-4655	RESISTOR WW, 11K 5W ± 5% (OHMITE)
22	2	242E6205	NW 4Ω 3W ± 5% (SPRAGUE)
21	1	242E6805	WW, 68Ω 3W ± 5% (SPRAGUE)
20	1	RC32GF470J	COMP 47Ω 1W ± 5%
9	1	3006P-1-101	VARIABLE, 100Ω 20% (BOURNS)
8	1	RC20GF101J	COMP, 100Ω 1/2W ± 5%
17	1	RC20GF123J	COMP 12K 1/2W ± 5%
16	1	RN60C3011F	FILM 30.1K 1/8W ± 1%
15	1	RC20GF363J	COMP, 36KΩ 1/2W ± 5%
14	1	RC20GF822J	COMP 8200Ω 1/2W ± 5%
13	1	RN60C3091F	FILM 3090Ω 1/8W ± 1%
12	1	RN60C8871F	FILM, 8870Ω 1/8W ± 1%
11	2	3006P-1-501	VARIABLE 500Ω ± 20% (BOURNS)
10	2	3006P-1-502	VARIABLE 5K ± 20% (BOURNS)
9	1	RC20GF321J	COMP 320Ω 1/2W ± 5%
8	2	RC20GF222J	COMP 2.2K 1/2W ± 5%
7	3	RC20GF102J	COMP, 1000Ω 1/2W ± 5%
6	1	RC20GF331J	COMP 330Ω 1/2W ± 5%
5	2	3006P-1-203	VARIABLE 20K ± 20% (BOURNS)
4	1	RN60C2671F	FILM, 2670Ω 1/8W ± 1%
3	1	RN60C6041F	FILM, 6040Ω 1/8W ± 1%
2	1	RC20GF682J	RESISTOR, COMP 6.8K 1/2W ± 5%
1	1	D12810	PRINTED WIRING BOARD

REMOVE BURRS, BREAK ALL SHARP EDGES .005 MAX

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES: SURF. ROUGHNESS .XX ± EXCEPT .XXX ± AS ANGLES ± NOTED

MATL

FINISH

E12759 NEXT ASSY | 880 USED ON

APPLICATION

DRN [illegible] 2/26/76
CHK [illegible] 3/10/76
APPD [illegible] 3/10/76

PARTS LIST

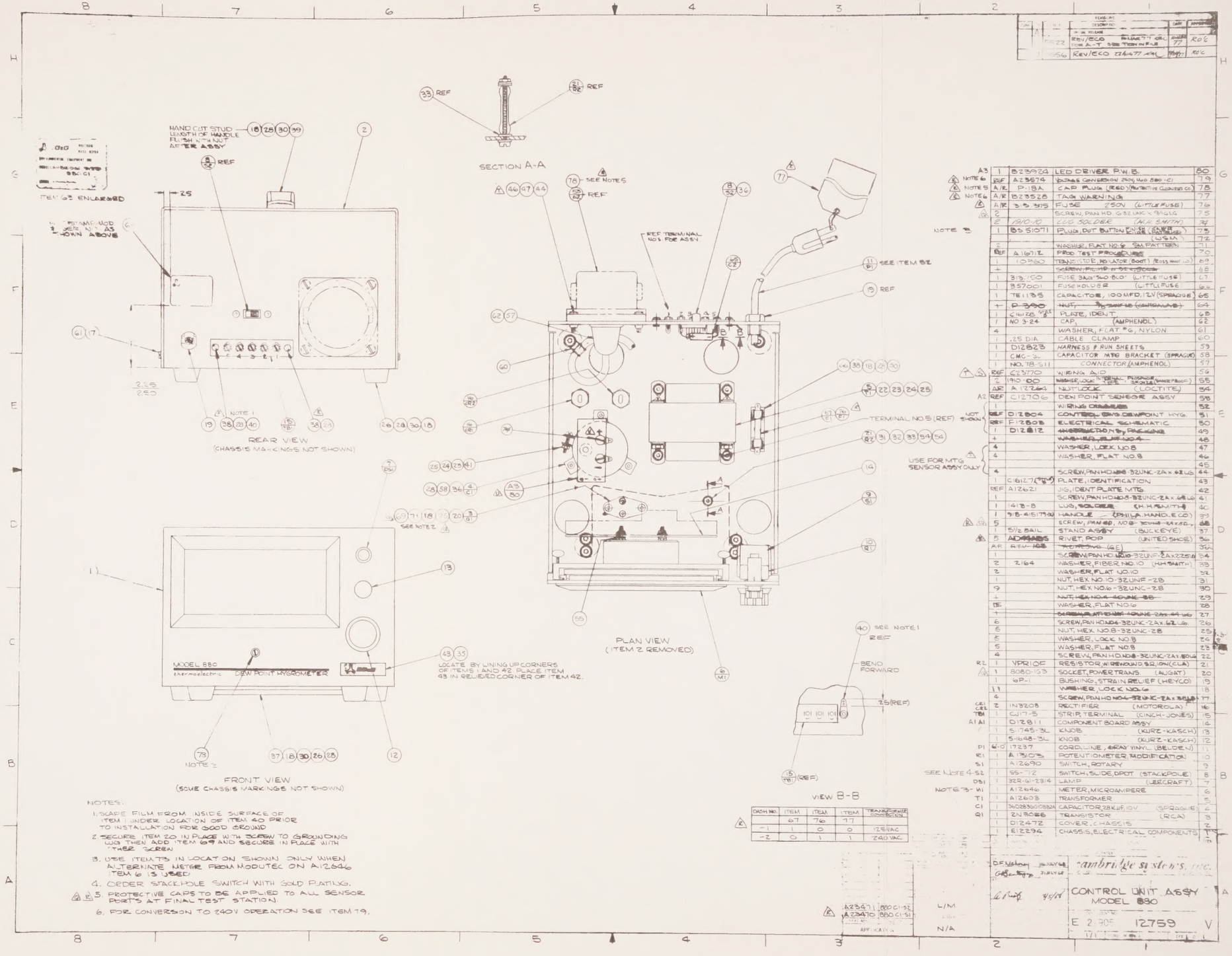
EG&G CAMBRIDGE SYSTEMS OPERATION NEWTON MASSACHUSETTS

COMPONENT BOARD ASSY

SIZE D | CODE IDENT NO. 22905 | 12811 | REV U

SCALE 2:1 | SHEET 1 OF 1

Figure 10. Component Board Assy, D12811.


REAR VIEW
(CHASSIS MARKINGS NOT SHOWN)
SECTION A-A
PLAN VIEW
(ITEM 2 REMOVED)
FRONT VIEW
(SOME CHASSIS MARKINGS NOT SHOWN)
VIEW B-B
ITEM 62 ENLARGED
MODEL 880
thermoelectric
DEW POINT HYGROMETER
LOCATE BY LINING UP CORNERS OF ITEMS 1 AND 42. PLACE ITEM 43 IN RELIEVED CORNER OF ITEM 42.
BEND FORWARD
TERMINAL NO.5 (REF)
SEE ITEM 62
SEE NOTES
REF TERMINAL NOS. FOR ASSY.
HAND CUT STUD LENGTH OF HANDLE FLUSH WITH NUT AFTER ASSY
NOTES:
1. SCRAPE FILM FROM INSIDE SURFACE OF ITEM 1 UNDER LOCATION OF ITEM 40 PRIOR TO INSTALLATION FOR GOOD GROUND
2. SECURE ITEM 20 IN PLACE WITH SCREW TO GROUNDING LUG THEN ADD ITEM 69 AND SECURE IN PLACE WITH OTHER SCREW
3. USE ITEMS IN LOCATION SHOWN ONLY WHEN ALTERNATE METER FROM MODUTEC ON A12646 ITEM 6 IS USED.
4. ORDER STACKPOLE SWITCH WITH GOLD PLATING.
5. PROTECTIVE CAPS TO BE APPLIED TO ALL SENSOR PORTS AT FINAL TEST STATION.
6. FOR CONVERSION TO 240V OPERATION SEE ITEM 79.

DASH NO.	ITEM 67	ITEM 76	ITEM 77	TRANSFORMER CONNECTION
-1	1	0	0	120 VAC
-2	0	1	1	240 VAC

A3	1	B23924	LED DRIVER P.W.B.	80
NOTE 6	REF	A23874	VOLTAGE CONVERSION 240V MOD 880-C1	79
NOTE 5	A/R	P-19A	CAP PLUG (RED) (PROTECTIVE CLOSURES CO)	78
NOTE 6	A/R	B23528	TAG WARNING	77
	A/R	3.5 375	FUSE 250V (LITTLE FUSE)	76
	2		SCREW, PAN HD 6-32 UNC X 3/16 LG	75
	2	1910-10	LUG SOLDER (H.H. SMITH)	74
NOTE 5	1	BS 51071	PLUG, DOT BUTTON FILLER (STACKPOLE)	73
			(USA)	72
	2		WASHER, FLAT NO. 6 SM PATTERN	71
	REF	A16712	PROD TEST PROCEDURE	70
	1	10760	TRANSISTOR INSULATOR (BOOT) (ROSS MANUF. CO)	69
	+		~~SCREW, PAN HD 6-32 UNC-2B~~	68
	1	313.160	FUSE 3AG 1/4 SLO BLO (LITTLE FUSE)	67
	1	357001	FUSEHOLDER (LITTLE FUSE)	66
	1	TE1185	CAPACITOR, 100 MFD, 12V (SPRAGUE)	65
	+	P-3606	~~NUT, 3/8-32 UNF-2B (CAMLOCK)~~	64
	1	C16126	PLATE, IDENT	63
	1	NO 3-24	CAP (AMPHENOL)	62
	4		WASHER, FLAT #6, NYLON	61
	1	.25 DIA	CABLE CLAMP	60
	1	D12823	HARNESS & RUN SHEETS	59
	1	CMC-3	CAPACITOR MTG BRACKET (SPRAGUE)	58
	1	NO. 78-S11	CONNECTOR (AMPHENOL)	57
	REF	623770	WIRING AID	56
	2	1910-00	~~WASHER, LOCK #4 INT. (SHAKEPROOF)~~	55
	AR	A12264	NUT LOCK (LOCTITE)	54
A2	REF	C12706	DEW POINT SENSOR ASSY	53
			~~WIRING CHANGES~~	52
NOT SHOWN	REF	D12804	CONTROL BOARD DEW POINT HYG.	51
	REF	F12808	ELECTRICAL SCHEMATIC	50
	1	D12812	~~INSTRUCTION BOOK ENGLISH~~	49
	+		~~WASHER, FLAT NO 4~~	48
	4		WASHER, LOCK NO 8	47
	4		WASHER, FLAT NO 8	46
				45
	4		SCREW, PAN HD #8-32 UNC-2A x 6.2 LG	44
	1	C16127 (TYPE 5)	PLATE, IDENTIFICATION	43
	REF	A12621	JIG, IDENT PLATE MTG	42
	1		SCREW, PAN HD #8-32 UNC-2A x 6.2 LG	41
	1	418-8	LUG, SOLDER (H.H. SMITH)	40
	1	918-415179W	HANDLE (PHILA. HANDLE CO)	39
	5		SCREW, PAN #8, NO 8-32 UNC-2A x 5/8 LG	38
	1	5 1/2 BAIL	STAND ASSY (BUCKEYE)	37
	5	~~ADHESIVE~~	RIVET, POP (UNITED SHOE)	36
	A/R	~~ATV-10~~	~~POTTING (GE)~~	35
	1		SCREW, PAN HD #10-32 UNF-2A x 2.25 LG	34
	2	2164	WASHER, FIBER NO. 10 (H.H. SMITH)	33
	2		WASHER, FLAT NO. 10	32
			NUT, HEX NO. 10-32 UNF-2B	31
	9		NUT, HEX NO. 6-32 UNC-2B	30
	+		~~NUT, HEX NO #4 40 UNC-2B~~	29
	15		WASHER, FLAT NO. 6	28
	+		~~SCREW, FLAT FILLISTER #4 40 UNC-2A x .94 LG~~	27
	6		SCREW, PAN HD #4-32 UNC-2A x .62 LG.	26
	5		NUT, HEX. NO. 8-32 UNC-2B	25
	5		WASHER, LOCK NO. 8	24
	5		WASHER, FLAT NO. 8	23
	4		SCREW, PAN HD #8-32 UNC-2A x .50 LG	22
R2	1	VDR10C	RESISTOR, WIREWOUND 5Ω, 10W (CLR)	21
	1	8080-193	SOCKET, POWER TRANS. (ALIGAT)	20
	1	6P-1	BUSHING, STRAIN RELIEF (HEYCO)	19
	11		WASHER, LOCK NO 6	18
	4		SCREW, PAN HD #6-32 UNC-2A x 3/8 LG	17
CR1 CR2	2	1N3208	RECTIFIER (MOTOROLA)	16
TB1	1	CJ17-5	STRIP, TERMINAL (CINCH-JONES)	15
A1A1	1	D12811	COMPONENT BOARD ASSY	14
	1	S-745-3L	KNOB (KURZ-KASCH)	13
	1	S-1648-3L	KNOB (KURZ-KASCH)	12
P1	6-0	17237	CORD, LINE, GRAY VINYL (BELDEN)	11
R1	1	A13605	POTENTIOMETER MODIFICATION	10
S1	1	A12690	SWITCH, ROTARY	9
SEE NOTE 4 S2	1	88-712	SWITCH, SLIDE, DPDT (STACKPOLE)	8
DS1	1	328-61-2314	LAMP (LEECRAFT)	7
NOTE 3 M1	1	A12646	METER, MICROAMPERE	6
T1	1	A12603	TRANSFORMER	5
C1	1	3602B3600B824	CAPACITOR, 2.8K μF, 10V (SPRAGUE)	4
Q1	1	2N3055	TRANSISTOR (RCA)	3
	1	D12472	COVER, CHASSIS	2
	1	E12294	CHASSIS, ELECTRICAL COMPONENTS	1

A23471	880C1-52	L/M	cambridge systems, inc.
A23470	880C1-51	N/A	CONTROL UNIT ASSY MODEL 880
APPLICABLE			E 2 905 12759 V

Figure 11. Control Unit Assy, Model 880, E-12759.

MP MASTER
MA21717